



National Transportation Safety Board

Pipeline Accident Brief

Natural Gas Explosion at Educational Facility

Minneapolis, Minnesota

August 2, 2017

The Accident

On August 2, 2017, at 10:22 a.m., local time, a building on the north campus of the Minnehaha Academy, a private school in Minneapolis, Minnesota, was destroyed by a natural gas explosion. Figure 1 shows an aerial view of the north campus prior to the accident, with a yellow arrow pointing toward the explosion site. Figure 2 is a photograph of the accident site taken after the building explosion, with emergency responders and gas company personnel on scene. At the time of the explosion, two workers were installing piping to support the relocation of gas meters from the basement of the building to the outside. Two new meters mounted on an exterior wall were ready for the piping to be connected. While workers were removing the existing piping, a full-flow natural gas line at pressure was opened. The workers were unable to control the release of the gas; thus, they evacuated the building and warned others to evacuate. The explosion occurred during their evacuation. Two individuals were killed, and nine others were injured.¹



Figure 1. Photograph of north campus area at Minnehaha Academy prior to explosion. (Source: minnehahaacademy.net.)

¹ For more detailed information about this accident investigation and documents referenced in it, see the National Transportation Safety Board's (NTSB) public docket at <https://www.ntsb.gov/investigations/SitePages/dms.aspx> and search for accident number DCA17MP007.

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Figure 1. Photo of accident site taken after building explosion. (Source: Minneapolis Fire Department.)

The Accident Site

Minnehaha Academy was in recess for summer vacation, but 36 Academy staff were present to perform administrative tasks. Six students and the basketball coach were in the gymnasium. The basement of the central building structure contained a utilities/storage room, a boiler room, and a “utility bunker.” The utility bunker was an extension of the basement spaces constructed beneath a ground-level concrete slab that extended out from the west basement wall of the building. The utility bunker, which was outside the foundation footprint of the building, contained the gas service meter equipment and was accessed by a basement door from the boiler room.

CenterPoint Energy Minnesota Gas

Natural gas was supplied to the school by CenterPoint Energy Minnesota Gas (CPEMG). CPEMG performed maintenance on its own natural gas service meters and distribution pipelines and also hired contractors to perform specialized pipefitting services. The maintenance activity on the day of the accident was being performed by such a contractor.

Gas was supplied to the school through two meters, an arrangement that allowed the gas company flexibility in its ability to supply gas to customers. When the demand for natural gas is high (for example, when outdoor temperatures are cold) and CPEMG may need delivery capacity elsewhere in its system, CPEMG offers commercial customers the option, if they have the ability, to use either natural gas or, alternately, some other form of fuel such as fuel oil. CPEMG may offer the customer advantageous pricing if the customer is willing to shift to the alternate fuel at that time. CPEMG supports this alternate fuel supply arrangement by the installation of (1) a “firm” customer gas meter that supplies a continuous source of gas for appliances that require an uninterrupted gas supply, such as for hot water or cooking, and (2) an “interruptible” customer gas meter that can interrupt (temporarily suspend) the flow of gas that would supply appliances such as large boilers, where the appliance can be readily switched over to the alternate fuel source.

Minnesota Office of Pipeline Safety

Jurisdictional pipes fall under the Minnesota Office of Pipeline Safety (MNOPS) for safety oversight to ensure enforcement for construction, operations, and maintenance pursuant to Title 49 *Code of Federal Regulations (CFR)* Part 192 Transportation of Natural and Other Gas by Pipeline – Minimum Federal Safety Standards. Non-DOT jurisdictional pipes (also called customer pipes) do not fall under federal requirements; instead, these pipes belong to the gas customers and are constructed under permit from the local jurisdiction. Generally, customer piping within a facility up to the outlet of the service meter are nonjurisdictional; whereas, from the service meter outward to the distribution system, they are jurisdictional.

Master Mechanical, Incorporated

Master Mechanical, Inc. (MMI) was the contractor hired by CPEMG to perform the pipefitting work at the accident site. MMI is a professional mechanical contracting company, based in Eagan, Minnesota, that has about 125 employees; the technical field personnel were hired through local unions, which provided apprenticeship training programs.

The MMI work involved a project to relocate the gas service meters from the inside of the building to the outside of that building. The construction print ticket for the specific phase of the project involving the MMI personnel on the day of the accident included connecting CPEMG's relocated meters using 2-inch black threaded gas piping, welding 4-inch gas piping, welding underground pipes, conducting core-drilling as necessary, performing the work during normal business hours, and securing the Minneapolis city permit for the work. About a month prior, CPEMG had installed two new sets of gas service meter equipment on the outside of the building.

The MMI on-site work crew consisted of a field foreman and a construction helper; the field foreman was the father of the construction helper. The field foreman was trained to the job classification level of a journeyman/pipefitter, and he was hired by MMI in March 2009 and had worked there about 8 years. He had held the journeyman/pipefitter job classification for about 5 years. Although the journeyman/pipefitter was licensed and trained to meet state and local requirements, he was not qualified to work on DOT-jurisdictional piping. He had not completed the CPEMG Operator qualifications program, as required by 49 *CFR* Part 192, Subpart N, to work on the covered tasks associated with jurisdictional piping.

The construction helper, who was working on the gas piping immediately preceding the explosion, was a part-time employee. He was not trained to any pipefitter job classification level. He was initially hired by MMI in June 2015, departing and returning to the company in January 2017. At the time of the accident, the construction helper had been in that job position for less than 6 months, with total accumulated work experience with MMI of a little more than 8 months. The construction helper also had not completed the CPEMG operator qualifications program.

CPEMG contracted with MMI to perform piping modifications to support the relocation of the gas meters from inside the building to the outside of the building. Normally, CPEMG would send a contract work request to MMI, which would then respond by sending CPEMG an acceptance letter to execute the project at a cost, which would then become the contract agreement. However, for the Minnehaha Academy Upper School meter relocation project, the CPEMG stated

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contract with MMI was the MMI proposal (work bid) for the project. The written terms of the contract were as follows:

MMI would:

- Connect CPEMG's relocated meters to the building
- Use 2-inch black threaded gas piping
- Weld 4-inch gas piping
- Weld underground pipes
- Conduct core drilling as necessary
- Perform the work during normal business hours
- Secure the Minneapolis City permit for the work

MMI would not:

- Paint
- Start-up or re-light customer equipment
- Pressure test customer piping
- Work overtime
- Demolish piping,
- Work on existing meter
- Dig underground

There was no additional or specific written documentation on the terms of the proposal.

On the day of the accident, the two-person MMI pipefitting contractor crew was making modifications to piping upstream of the firm and interruptible meters, meaning the two-person crew was working on jurisdictional piping. Figure 3 is a photo taken before the accident showing the vault area of the center section of the building basement and describing the individual damaged piping elements involved in the accident. The photo depicts the location of the nonjurisdictional section of gas pipe and the jurisdictional piping that was being dismantled by the contractor work crew during the accident.

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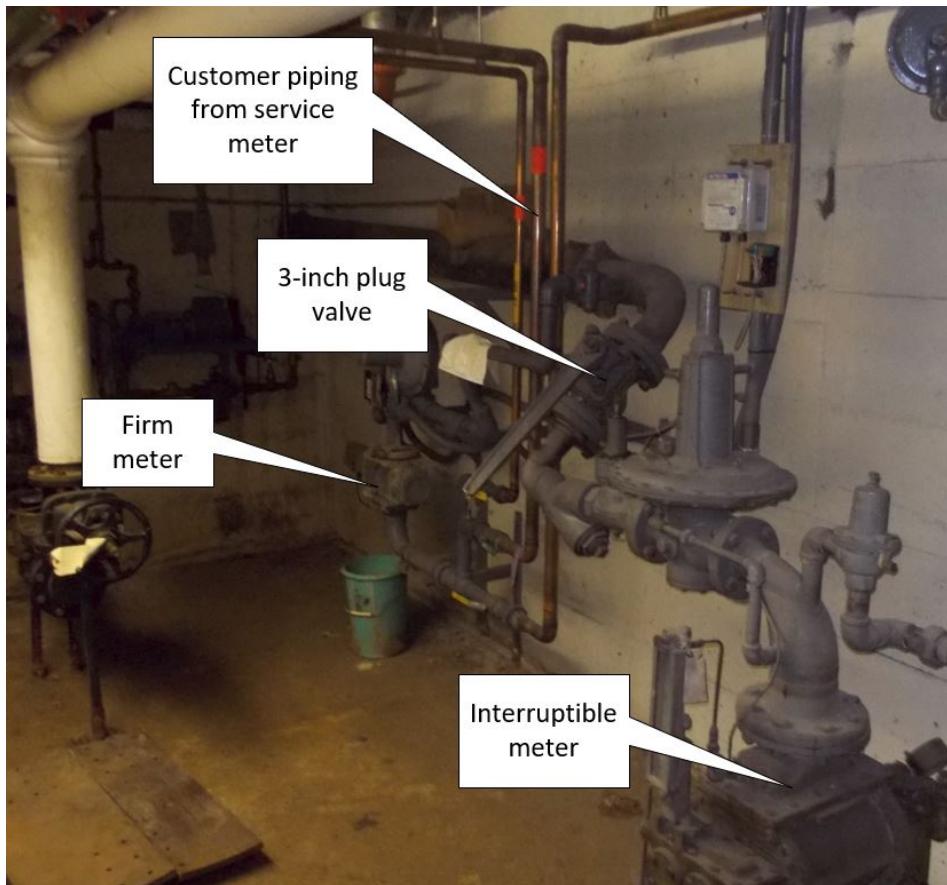


Figure 3. Photo taken before the accident of vault area of the center section of the building basement. (Source: CPEMG.)

Natural Gas Service System

Natural gas service to the school could be shut off using the manually operated customer service valve (also known as a curb valve or fire valve), which was located in an underground valve box (also known as a curb box). Beyond the curb valve, the natural gas supply line penetrated the utility bunker wall and branched to supply gas to the firm and interruptible meters. The branch to the interruptible meter passed through a manually operated plug valve (involved in the accident), manufactured by The Walworth Company. The end of the plug is square, for attachment of a handle having a compatibly sized opening to accommodate the square stub on the plug. The handle can be attached in any of four different orientations. The square hole of the handle was also equipped with a setscrew to lock the handle in place. The plug in the valve turns 90 degrees; in one orientation, a passage through the plug aligns with the attached piping and gas can flow; when turned 90 degrees, to achieve the closed position, the passage is perpendicular to the attached piping and gas cannot flow.

Both the curb valve (outside the accident building) and the 3-inch Walworth plug valve (located in the utility bunker) were part of the “distribution system,” and as such, both comprised the “regulated” section of the gas service pipeline. The Walworth Lubricated Plug Valve (product line) service manual for the type of plug valve involved in the accident recommends that the in-service valve be periodically lubricated, although there is no specific time when such maintenance should be performed.

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CPEMG maintenance records reviewed during the investigation indicated the following:

- Maintenance on the customer curb valve was performed at least three times in the 5 years prior to the accident (in December 2012 and twice in November 2013); however, no notations were cited in the documentation that indicated the operating conditions of the curb valve or specific maintenance activities that were performed on that curb valve.
- CPEMG provided documentation of the following activities which CPEMG indicated would have required the Walworth plug valve to be exercised: an interruptible meter oil change that took place on December 2, 2011, a pressure test associated with the service line replacement in 2002, and a pressure test associated with the installation of a Kerotest valve in 1971. CPEMG further indicated that meter oil changes would have been completed about every 5 years since the plug was installed in 1959.

Activities Immediately Preceding the Explosion

On the day of the accident, the MMI field foreman and construction helper were at the job site to perform the piping relocation work. CPEMG did not have any employees at the job site at the time of the explosion; the closest CPEMG employee was a block away in a company vehicle awaiting arrival of a construction vehicle that was enroute to the job site.

National Transportation Safety Board (NTSB) interview statements by the two MMI employees indicated that, prior to the explosion, they had encountered a plug valve that was connected to and located immediately prior to the interruptible meter in which the wrench was “stuck” in the closed position (that is, the wrench could not be turned). The construction helper stated that he knew the valve was closed because the wrench was positioned perpendicular to the valve piping (the inlet/outlet connection ports of the valve).

The field foreman also stated that he had determined that the plug valve was closed and that it was safe for the construction helper to begin disassembling piping downstream of the valve. Based on NTSB interviews, upon instruction from the field foreman, the construction helper, working alone in the utility bunker, was then assigned to disconnect the piping from the interruptible gas service meter.

A school maintenance worker located on a floor above the basement heard a “horrendous flow of air,” and he immediately went to investigate the strong odor of natural gas and the loud noise coming from the basement. As he exited the basement, he made an announcement over his handheld radio that there was gas in the building and to evacuate immediately. As he made his radio announcement, he ran up the stairs and searched for occupants. Less than 1 minute later, the building exploded.

Emergency Response

At 10:23:06 a.m., the Minneapolis Emergency Communications Center received a call reporting the incident, which was initially described as a building collapse. After several subsequent 9-1-1 calls, this was amended to an explosion with fire response, in which it was also indicated “2 people were buried under a wall.” The Minneapolis Fire Department (MFD) was

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dispatched at 10:24:39 a.m., and the first unit arrived at 10:30:57 a.m. The MFD response eventually totaled 31 emergency services vehicles and at least 79 MFD personnel. The Minneapolis Police Department was also dispatched to the scene. The arriving MFD personnel observed debris in the parking lot in front of the school building and reported a “strong odor of gas” in that area. They also observed a structural collapse of a section of the school building, with an ensuing fire within the collapsed structure debris, along with numerous blown out windows in the remaining noncollapsed sections of that building.²

An apparent free flow of burning natural gas was occurring beneath the debris pile of the collapsed structure, which resulted in an inability to suppress the fire. The curb valve was beneath debris remnants of a collapsed brick wall, which was cleared by on-scene personnel; CPEMG closed this valve at 11:18 a.m. The fire was subsequently suppressed by firefighters.

Summary of Damage/Injuries

The estimated total property damages resulting from the explosion and fire were about \$30 million.³ Two individuals were killed, and nine were injured as a result of the explosion and fire. The injured were transported to local medical facilities by the jurisdictional ambulance services for medical evaluation and/or treatment. About 42 staff members and students, were evacuated from the school immediately prior to the explosion.

The Investigation

Examination of Plug Valve

The on-scene examination by the NTSB of the plug valve, which the two MMI on-site employees had identified as having been “stuck” in the closed position, showed that the valve wrench was positioned perpendicular to the piping. Disassembly of the valve components showed that the internal “flow control” component of the valve (the valve plug) was in the open position. The investigators were unable to determine how the valve wrench became positioned in that perpendicular orientation because preaccident photographs, provided by CPEMG and taken about 1.5 years prior to the accident, showed the wrench positioned parallel to the piping, thus indicating the valve was open.

It is customary to align the handle so that it is parallel with the piping when the valve is open and positioning the handle perpendicular to the piping when the valve is closed. However, confirmation of this is the responsibility of the crew working on the piping. This confirmation would entail removal of the handle and noting the position of plug assembly and viewing the indicator or witness mark on the body of the valve.

Briefly summarized, the NTSB Materials Laboratory report indicated (1) the valve wrench was found oriented perpendicular to the valve body, (2) the valve plug was oriented in the open

² Minneapolis Fire Department Incident Detail Report(s): Incident Number(s) 17-0028219 and 17-0028220 and interview (transcript) testimony of several witnesses to the emergency response at the scene, available in the NTSB public docket at <https://www.ntsb.gov/investigations/SitePages/dms.aspx> by searching for accident number DCA17MP007.

³ PHMSA Incident Report (Form F7100.1): Gas Distribution System, Number 20170111-16716, dated December 5, 2017.

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position, (3) “witness marks” were found on two surfaces of the valve stem that were consistent with contact by a valve wrench set screw, (4) the valve stem collar had embossed arrows indicating the state of the valve (open or closed), in which the arrows were oriented parallel to the direction of flow, which was consistent with the valve being open, and (5) measurements of 344 and then 152 foot-pounds of torque were required to rotate the valve wrench (handle) of an exemplar plug valve, which compared to a measurement of 721 foot-pounds of torque that was applied to the wrench (handle) of the accident plug valve that had been exposed to the fire and had a 4-foot extension attached to the wrench (for additional leverage), in which no rotation was achieved.

Postaccident Actions

Following the accident, CPEMG took action to improve the safety of its work activities, which was documented to the investigation as follows.⁴

Following the incident, Minnesota Gas [CPEMG] suspended company-initiated commercial meter moves from inside to outside. Over a period of several months, a cross-functional team including representatives from operations, engineering, purchasing, and compliance reviewed the existing process and ultimately recommended the following actions to improve project oversight, project documentation, and internal and external project communications. Minnesota Gas implemented these recommendations and has used the revised process several times now to successfully complete company-initiated commercial meter moves from inside to outside. The implemented initiative actions are briefly summarized as follows:

- Formally document the process for company-initiated commercial meter moves from inside to outside, beginning with identification of project need through completion in the field and assigning responsible parties for each step in the process, with oversight provided by a project manager who is accountable for the project in which—
 - The revised process includes written and verbal communications to affected customers throughout the project; multiple checkpoints with customers and mechanical contractors to coordinate work; defining the demarcation point between utility facilities and customer piping; and discussing when, where, and how gas will be turned off;
 - Based on feedback from the customer and through engineering review, a plan is tailored to meet the customer’s unique needs and to carry out the work at each location; and
 - On the tie-in day, a group safety meeting will be held at the worksite involving all parties (Minnesota Gas, customer, and mechanical contractor) to go over the plan, review each party’s responsibilities, and clarify any questions.

⁴ E-mail correspondence from CPEMG to NTSB, dated July 26, 2019 (mostly quoted verbatim).

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- Train and provide instruction to Minnesota Gas management, engineering, and field personnel on the revised process; the company's expectations; and their respective roles and responsibilities, with update and refresher training as needed.
- Send a letter annually to licensed mechanical contractors regarding the demarcation point between Minnesota Gas facilities and customer piping and reiterate they are not authorized to work on or operate Minnesota Gas facilities.
- For residential customers, information about the demarcation point between utility facilities and customer piping has also been published on the company's external website at <https://www.centerpointenergy.com/en-us/residential/safety/meter-safety?sa=mn>.

Minnesota Public Utility Commission Action

In response to the Minnehaha Academy accident and several similar prior natural gas release and explosion accidents, the Minnesota Public Utility Commission (MN-PUC) issued a memorandum, dated March 20, 2019, titled "Gas Utility Installation of Excess Flow Valves and Manual Service Line Shutoff Valves," which outlined the new requirement of the MN-PUC, mandating the installation of excess flow valves and manual service line shutoff valves for all Minnesota natural gas distribution systems. In addition, MN-PUC also provided a document, dated March 18, 2019, to the Minnesota Department of Commerce, Division of Energy Resources, that provides a description, a history, and the response from utilities related to the requirement for excess flow valves.

Minnesota Department Public Safety/Office of Pipeline Safety Action

In response to the Minnehaha Academy accident and in reference to case number 145744454-1, the Minnesota Department of Public Safety issued (1) a *Notice of Probable Violation* to CERC, relative to actions under 49 CFR 192.13(c) General, 49 CFR 192.703(a) General, and 49 CFR 191.9 Distribution System: Incident Report and issued (2) a *Warning Letter* to CERC, relative to actions under 49 CFR 192.605(b) Procedural Manual for Operations, Maintenance, and Emergencies and 49 CFR 192.727(d) Abandonment or Deactivation of Facilities.

Minnesota OSHA Action

Following the accident, Minnesota OSHA conducted an inspection of the accident site on August 3, 2017, in which CenterPoint Energy, Inc., issued official correspondence stating, "... the inspection resulted in no proposed citations."⁵

⁵ Reference correspondence Minnesota Department of Labor & Industry/Occupational Safety and Health Division to CenterPoint Energy, Inc., dated Jan. 12, 2018, RE "OSHA Inspection 318101185 OSHI ID: O1457 05317, Inspection Site 3100 W River Pkwy, Minneapolis, Minnesota, 55406"; for further information, see <https://www.dli.mn.gov/about-department/our-areas-service/minnesota-osha-compliance>.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the natural gas explosion at the Minnehaha Academy occurred when a pipefitting crew disassembled piping upstream of a gas service meter. Contributing to the accident was the lack of detailed documentation that clearly established the scope of work to be performed.

For more details about this accident, visit www.ntsb.gov/investigations/dms.html, and search for NTSB accident identification number DCA17MP007.

Date: December 2, 2019

The NTSB has authority to investigate and establish the facts, circumstances, and cause or probable cause of a pipeline accident in which there is a fatality or substantial property damage. (Title 49 *United States Code (USC)* Section 1131 – *General authority*.)

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties . . . and are not conducted for the purpose of determining the rights or liabilities of any person.” Title 49 *Code of Federal Regulations*, Section 831.4. Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report. (49 *USC*, Section 1154[b].)
